2004 Crop Residue Disposal Smoke Management Program

DEQ Technical Review of Boundary County and Rathdrum Prairie Airsheds

DRAFT FINAL REPORT

Prepared By:
Dan Redline
DEQ Coeur d'Alene Regional Office
December, 2004

2004 Crop Residue Disposal Smoke Management Program
DEQ Technical Review of Boundary County and Rathdrum Prairie Airsheds

Report Overview

This technical report will provide data and analysis of the air quality and meteorological conditions that occurred during the 2004 agricultural field burning season. These environmental factors were used by the Crop Residue Disposal Smoke Management Program (SMP) to make daily burn/no-burn decisions and to evaluate continuation of burns during a burn day. The report is organized to provide an overview of weather and air quality for the northern Idaho counties with an emphasis on the agricultural burning activity that occurred in Kootenai and Boundary counties. The report will include a section for each county and discuss the air quality data and other pertinent data available in each airshed to support the SMP. This report will not discuss the agricultural burning that occurs within the exterior boundaries of the Coeur d'Alene Indian Reservation.

Seasonal Weather

The seasonal weather patterns in north Idaho that effect crop production also substantially influence the crop residue smoke management program. During the field burning season, weather can vary from hot and dry to unseasonably cool and wet. This year was marked by heavy rains that hit the area, especially Kootenai and Benewah counties, in late August and mid-September. According to climate data maintained by the National Weather Service in Spokane (Table 1), the total precipitation for August was higher than normal while the September precipitation was normal. In August, measurable amounts of precipitation were recorded on eight days (0.54 inches on 8/6) and trace amounts of rain were recorded on three days. Precipitation was recorded on seven days in September (0.43 inches recorded on 9/11) and trace amounts on five days. The previous month of July was dry with only 0.08 inch of rain reported for the entire month.

Table 1. Climate Data from Spokane NWS Site - 2004

Parameter	August	September
Avg. Monthly Temperature, 2004	68.9 F	56.2 F
Historical Mean Monthly Temp	69.6 F	60.8 F
Total Monthly Precipitation, 2004	1.66 in	0.98 in
Historical Avg Monthly Precip	0.79 in	0.86 in
Heating Degree Day (base 65°F)	42	256
Historical Avg HDD (base 65°F)	35	165
Cooling Degree Day (base 65°F)	168	0
Historical Avg CDD (base 65°F)	177	39

Note: Heating degree-day (HDD) is a unit of measure to track heating requirements or fuel consumption. HDD is calculated by substracting the average daily temperature from 65°F when the average temperature is less than the base. Cooling degree-day (CDD) is a unit of measure to track the amount of energy needed to cool the air. CDD is calculated by subtracting the base temperature (65°F) from the average daily temperature when it is greater than the base.

The average monthly temperature for August 2004 was about normal when compared to the thirty-year average while September appears to be slightly cooler than the average. An evaluation of the heating and cooling degree-days seems to indicate that September was cooler than normal per the historical record.

Additional climate trends are available from the Coeur d'Alene Airport in Kootenai County, and for two locations in Boundary County, at Porthill (COOP) and Bonners Ferry (RAWS). Temperature and precipitation data for August and September are presented in the following table. The climate data for these sites were obtained from the Western Regional Climate Center website at www.wrcc.dri.edu . The historical averages were based on the thirty-year trend reported in the NCDC 1971-2000 Monthly Normals.

Table 2. Temperature and Precipitation Data for Kootenai and Boundary Counties

Parameter		Coeur d'Alene Airport Kootenai County	Bonners Ferry Boundary County	Porthill Boundary County
August		**August**		
Mean Temp (F)	2004	69.80	68.34	68.66
	30 yr Monthly Norm	69.2	66.7	65.4
Total Precip (inches)	2004	2.02	0.79	1.16
	30 yr Monthly Norm	1.16	1.07	1.21
September		**September**		
Mean Temp (F)	2004	58.69	56.38	55.71
	30 yr Monthly Norm	60.3	57.1	55.8
Total Precip (inches)	2004	2.86	1.19	1.37
	30 yr Monthly Norm	1.12	1.16	1.24

The data in Table 2 suggest that mean temperatures for August and September were normal as compared to the 30-year average at these locations. The precipitation data confirms that August and September were wetter than normal for Kootenai County. Totals for each month were above 2 inches with a two month total of 4.88 inches reported at the airport site. The one month precipitation totals at the CDA Airport are more than one standard deviation above the monthly mean for the period of record for that site. The Boundary County data indicated total precipitation was normal for both August and September.

The heavy rains that hit northern Idaho in August had a significant impact on the field burning season. No burning occurred from August 23 to August 27 because fields were too wet. Rainstorms hit the area again during the middle of September and no burning took place from September 13 to September 17. These rain events saturated the soils in certain areas. Field coordinators speculated that the saturated soils potentially had an impact on the performance of field burns by increasing the amount of smoke produced. Cool wet weather also stimulated new growth in the perennial grass fields prior to burning. In certain areas such as Boundary County, this "green-up" effect had a significant impact on coordinating good dispersion conditions with appropriate field conditions.

Other weather conditions that are not necessarily tracked by climate data records also impacted the field burning season. High pressure events which lasted several days reduced ventilation and dispersion conditions and limited burning during parts of August and September. These events are described in the 2004 season summary prepared by the contract meteorologist for ISDA.

Air Quality Standards

In north Idaho, air quality monitoring for the National Ambient Air Quality Standards (NAAQS) is focused on particulate matter (PM). Particulate matter has two size based standards, $PM_{2.5}$ and PM_{10}. $PM_{2.5}$ is particulate matter less than or equal to 2.5 microns in aerodynamic diameter and is usually associated with combustion sources. PM_{10} is particulate matter less than or equal to 10 microns in aerodynamic diameter. PM_{10} measurements include the $PM_{2.5}$ fraction in addition to larger particles that are generally associated with mechanical processes such as mineral processing and geologic sources such as wind-blown dust. $PM_{2.5}$ is a good environmental indicator for monitoring the impact of all sources of smoke including agricultural burning.

Air quality was measured by reference methods for $PM_{2.5}$ at sites in Bonners Ferry (Kootenai Tribe of Idaho), Pinehurst, and St. Maries. These sites collect air quality samples for comparison to the NAAQS on a predetermined sampling schedule. No samples were collected in Kootenai and Bonner counties with the $PM_{2.5}$ reference method. The sites in Bonners Ferry, Pinehurst and St. Maries operated on a one-in-three schedule which would generate 31 samples for the quarter. DEQ collected 31valid samples at each site in Pinehurst and St. Maries. The Kootenai Tribe encountered equipment problems during the third quarter and collected 22 valid samples. Correlating the Federal Reference Method (FRM) $PM_{2.5}$ data with agricultural burning and the CRD Smoke Management Program is difficult because the fixed sampling schedule reduces the possibility that a sample day is also a burn day. In Boundary County, seventeen burn days overlapped on seven scheduled sample days.

The USEPA has presently established the $PM_{2.5}$ NAAQS at 65 $\mu g/m^3$ for the 24-hour standard and 15 $\mu g/m^3$ for the annual average. $PM_{2.5}$ concentrations above the NAAQS (>65 $\mu g/m^3$) are unhealthy for the general public. $PM_{2.5}$ concentrations from 16 to 65 $\mu g/m^3$ can also cause health problems especially for sensitive populations including adults with respiratory and/or cardiovascular diseases.

The highest 24-hour concentration measured during the third quarter was 23.5 $\mu g/m^3$ on September 30, 2004. The Coeur d'Alene Tribe reported that growers burned 1,317 acres within the reservation boundaries on the same day. Prescribed forestry burning was also taking place at the same time. It is unknown what contribution smoke from agricultural burning or forestry prescribed burning had on the PM2.5 concentration measured on the September 30. Third quarter FRM data are presented in Figure 1 below.

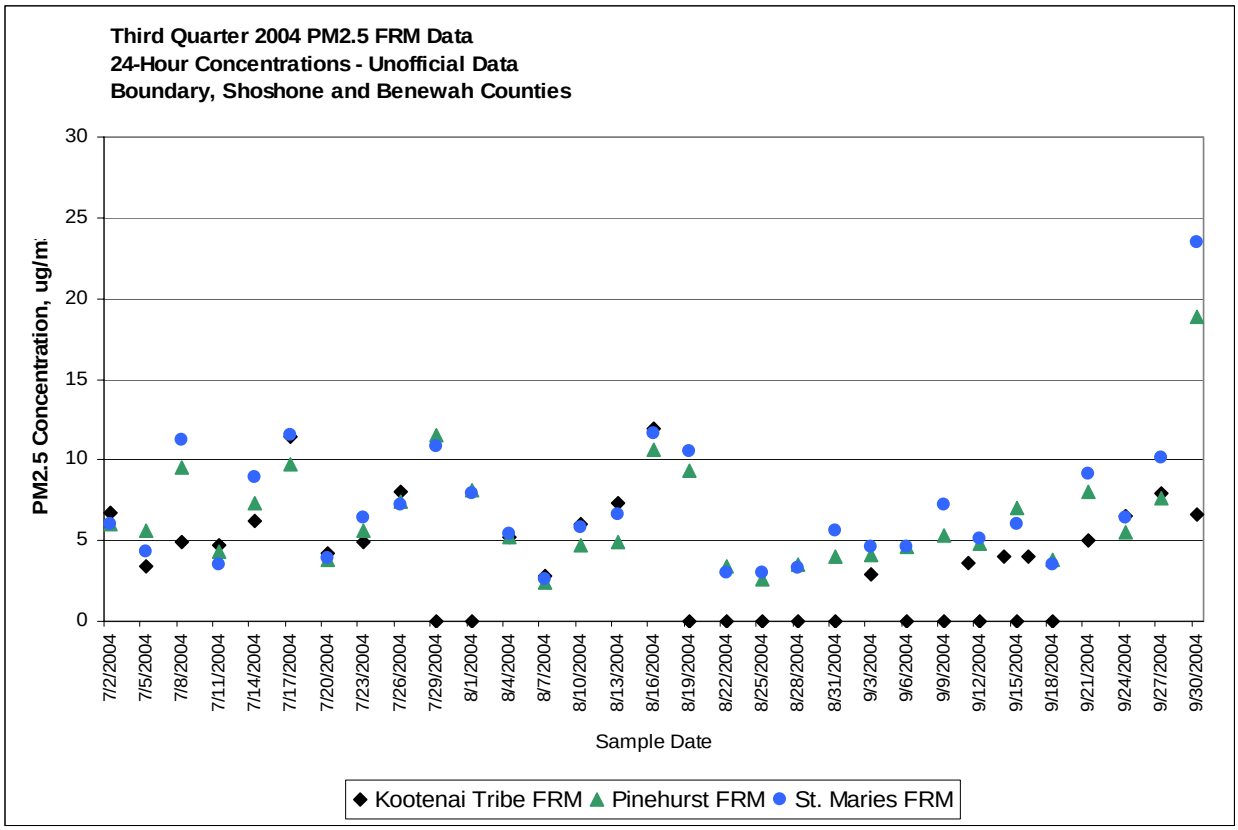


Figure 1. Third Quarter 2004 $PM_{2.5}$ FRM Data from Three North Idaho Monitoring Sites

Based on the FRM data, there was only one day during the third quarter when $PM_{2.5}$ concentrations were above 15 $\mu g/m^3$ for the 24-hour average. $PM_{2.5}$ concentrations between 15.5 and 40.4 $\mu g/m^3$ fall into the Moderate Air Quality Index (AQI) category. Concentrations below 15.5 $\mu g/m^3$ are in the Good AQI category. When particulate concentrations increase and move into the Moderate range or higher, the health effects triggered by the higher concentrations become more noticeable. Individuals with compromised respiratory systems or cardiovascular problems may be especially sensitive to increased particulate concentrations.

The FRM network provides the highest quality $PM_{2.5}$ data as a result of the state's quality assurance program which follows stringent federal guidelines. However, the data is not collected in real-time and only provides a single data point for a 24-hour period. The FRM sampling schedule is not continuous, so there is low probability of collecting a sample on a burn day. Smoke impacts that occur from agricultural burning are typically short-lived, between one to three hours in duration. As a result, the FRM sampling network does not provide adequate temporal resolution of $PM_{2.5}$ concentrations for smoke managers to evaluate the effectiveness of the smoke management program.

To improve the tracking of short-term changes in $PM_{2.5}$ concentrations for the CRD program, DEQ has invested in monitoring equipment that collects PM data continuously and reports hourly $PM_{2.5}$ or PM_{10} concentrations. The types of equipment used and the location of monitoring sites are discussed further in the next section. These continuous methods provide improved time resolved data but the collection method does not qualify as a reference technique per USEPA requirements. The continuous $PM_{2.5}$ data can be compared to the NAAQS but cannot be used to officially determine compliance with the NAAQS.

August $PM_{2.5}$ real-time data are presented in Figures 2 and 3 below. These graphs show the rolling 24-hour average $PM_{2.5}$ concentration at several different sites. The continuous data provides a more complete picture of the PM2.5 temporal variability that exists in each area and may provide additional insights on the types of sources that are affecting changes in $PM_{2.5}$ concentrations. The real-time monitoring network is discussed in greater detail in the following section.

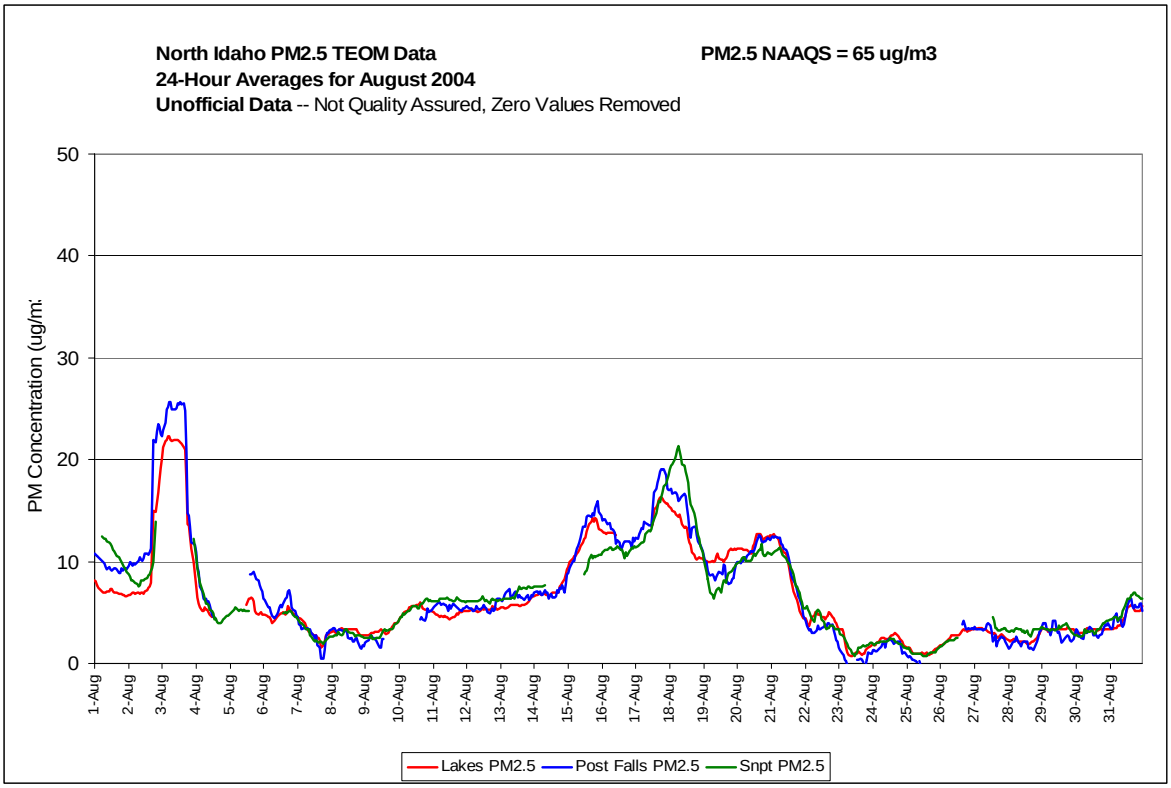


Figure 2. Continuous $PM_{2.5}$ Data from Three Real-time Sites for August 2004.

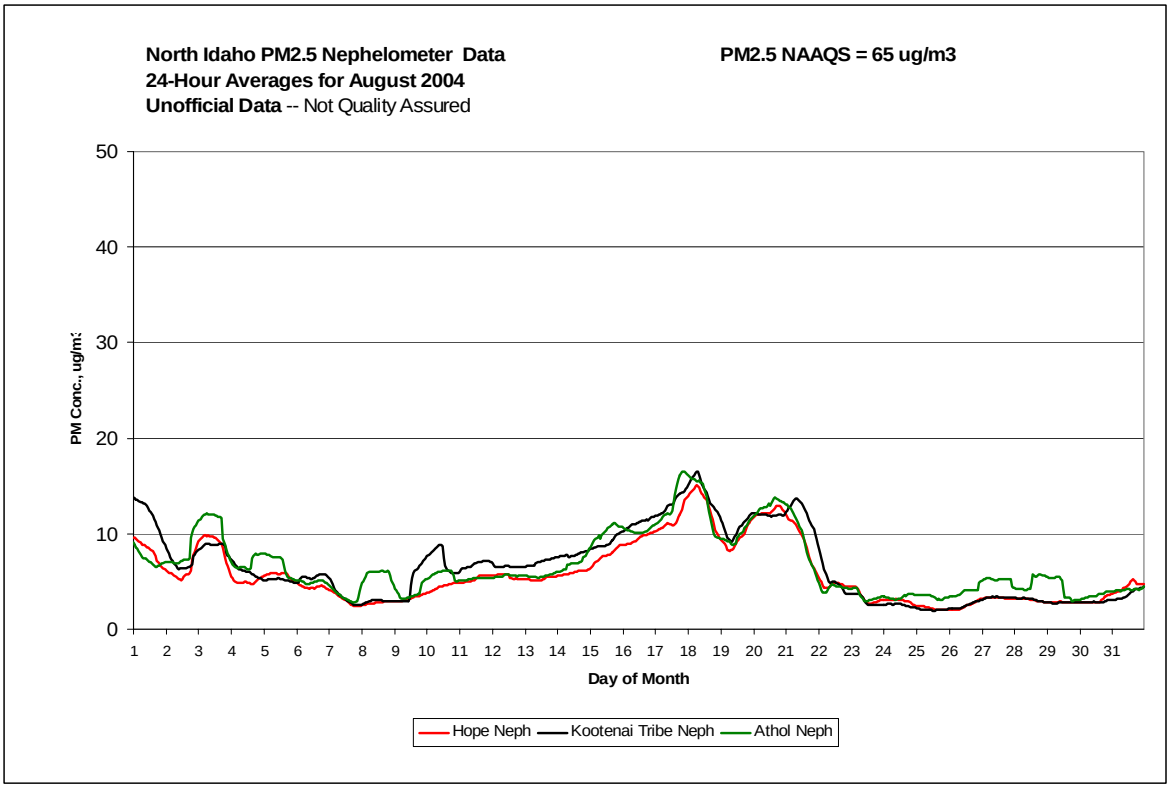


Figure 3. Continuous $PM_{2.5}$ Data from Three Nephelometer sites for August 2004.

Air Quality Monitoring Network

Due to the highly controversial nature of agricultural burning in north Idaho, the DEQ office in Coeur d'Alene developed a supplemental air quality monitoring network that is deployed seasonally for the CRD smoke management program to compliment the year-round monitoring network. Equipment for this supplemental network was funded primarily from Rathdrum Prairie grower registration fees that were received by DEQ and managed by a local smoke management advisory committee. DEQ was an ex-officio member of the advisory committee when it was active from 1985 to 2003. Legislative changes in 2003 resulted in termination of the smoke management advisory committee in Kootenai County and the designation of the Idaho Department of Agriculture as the agency for receipt of registration fees.

The supplemental network consists of several portable real-time samplers that are deployed in late July and generally removed from the field in late October or early November. DEQ designed and constructed these portable sampling stations to measure particulate matter continuously using a light scattering technique. The sampling platform includes a datalogger to store sample results and a phone modem for remote access. The equipment is housed in a weatherproof enclosure that is thermostatically controlled. Three samplers are strategically located at sites downwind of the Rathdrum Prairie at locations in Rathdrum, Athol and East Hope. Two sites were discontinued this year, Fighting Creek and Meyer Ranch, after evaluating data from previous years and considering other monitoring priorities. Figure 4 shows the locations of these three sites with regards to the Rathdrum Prairie and other year-round AQ monitoring sites maintained by DEQ.

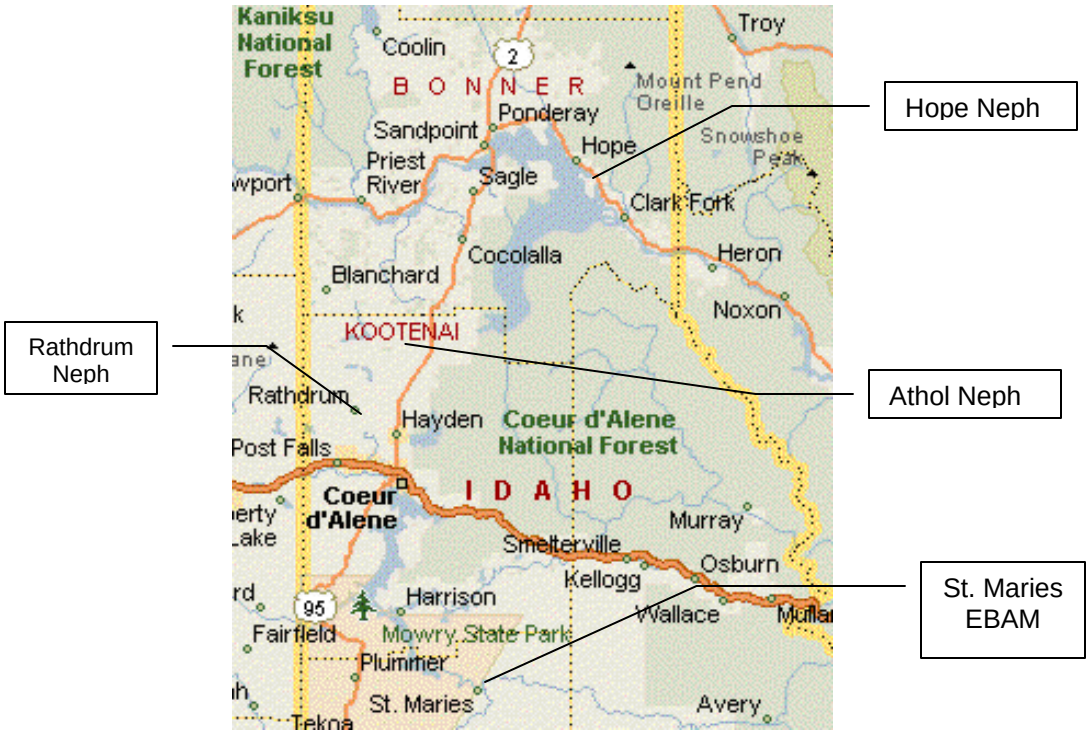


Figure 4. Map of supplemental air quality monitoring sites established by the Coeur d'Alene Regional office for field burning season.

A new real-time monitoring site was established in St. Maries this year using the E-BAM sampler that was purchased in 2003. The EBAM sampler was collocated with the FRM sampler at St. Maries site. The St. Maries site increased DEQ's real-time network into Benewah County and will assist with evaluating downwind smoke impacts from agricultural burning on the Coeur d'Alene Indian Reservation. This monitoring site complimented the air quality monitoring data that the Coeur d'Alene Tribe collected at sites the Tribe established in Plummer and Harrison.

DEQ maintains a fixed or year-round monitoring network at various locations throughout the four northern counties. DEQ also has developed partnerships with the Kootenai Tribe in Boundary County and with the Coeur d'Alene Tribe to provide technical assistance to their air quality monitoring programs. Collectively, this network consists of a variety of instruments that collect data to support the state and federal air quality monitoring goals. DEQ's regional network includes both $PM_{2.5}$ and PM_{10} monitoring equipment and meteorological monitoring as described below in Table 3.

Table 3. Description of Real-time Air Quality Monitoring Sites for 2004

Location	**County**	**Pollutant Measured & Time Period**	**Sample Method***
Bonners Ferry – Kootenai Tribe of Idaho	Boundary	$PM_{2.5}$ real-time Year-round	Nephelometer
Coeur d'Alene - Lakes Middle School	Kootenai	$PM_{2.5}$ real-time PM_{10} real-time Year-round	$PM_{2.5}$ TEOM PM_{10} TEOM
Post Falls - Syringa Well Site	Kootenai	$PM_{2.5}$ real-time Year-round	$PM_{2.5}$ TEOM
Sandpoint – USFS Ranger Station	Bonner	$PM_{2.5}$ real-time Year-round	$PM_{2.5}$ TEOM
Sandpoint - Sandpoint Middle School	Bonner	PM_{10} real-time Year-round	PM_{10} TEOM
E. Hope – EBSD Pump Station	Bonner	$PM_{2.5}$ real-time Seasonal	Nephelometer
Athol - City Athol Well Site North	Kootenai	$PM_{2.5}$ real-time Seasonal	Nephelometer
Rathdrum - Avista Odorizer Station	Kootenai	$PM_{2.5}$ real-time Seasonal	Nephelometer
St. Maries – USFS Bullpen Site	Benewah	$PM_{2.5}$ real-time Seasonal	$PM_{2.5}$ EBAM
Pinehurst - Pinehurst Elementary	Shoshone	$PM_{2.5}$ real-time PM_{10} real-time Year-round	$PM_{2.5}$ TEOM PM_{10} TEOM

*Description of sample methods follows in the next section.

Air Quality Sampling Techniques and Equipment

1. FRM

   Federal Reference Method (FRM) generally refers to the monitoring equipment that meets the USEPA requirements for measuring $PM_{2.5}$ for NAAQS determination. Data collected from these samplers are used to make the official determination of compliance with the $PM_{2.5}$ NAAQS. The FRM is the most accurate method for measuring this pollutant. The FRM sampler utilizes a filter-based sampling technique to collect a 24-hour integrated sample. Due to the rigorous quality assurance program for the FRM samplers, final data is not available until three months after sample collection.

   The FRM samplers are also used to 'calibrate' non-reference method techniques such as the real-time samplers. DEQ has used the FRMs collocated with TEOMs and nephelometers to develop $PM_{2.5}$ data correlations for the non-reference techniques. DEQ operated FRMs in Pinehurst and St. Maries during the 2004 field burning season. The Kootenai Tribe of Idaho also operated a FRM in Boundary County under a cooperative agreement with DEQ. The Coeur d'Alene Tribe established a monitoring site in Plummer that includes an FRM sampler.

2. TEOM

   DEQ operates and maintains an extensive network of TEOM (Tapered Element Oscillating Microbalance) samplers to measure $PM_{2.5}$ or PM_{10} concentrations in real-time. TEOMs have the ability to continuously sample and measure PM concentrations. They can be configured to measure PM_{10} or $PM_{2.5}$, depending on the data needs. In a PM_{10} configuration, the TEOM data meets USEPA criteria for PM_{10} as an equivalent method. DEQ submits PM_{10} TEOM data to the EPA database on a routine basis for compliance determination with the PM_{10} NAAQS. PM_{10} TEOMs were operated in Coeur d'Alene, Sandpoint and Pinehurst.

   Presently, there are no real-time methods approved by the USEPA for $PM_{2.5}$ sampling. In a $PM_{2.5}$ configuration, the data are also submitted to the EPA database but are not used for NAAQS compliance determination. DEQ collocates each $PM_{2.5}$ TEOM with a $PM_{2.5}$ FRM to establish a statistical correlation between the two instruments per an EPA protocol. DEQ operated $PM_{2.5}$ TEOMs in Sandpoint, Coeur d'Alene, Post Falls and Pinehurst during the 2004 fall season.

   The TEOMs can provide a fairly accurate measure of hourly PM concentrations. They can also calculate 8-hour and 24-hour rolling averages. The data are accessible remotely through telemetry techniques such as modem communication protocols. DEQ is working to post the real-time PM data to websites for public access.

3. NEPHELOMETER

   As mentioned previously, DEQ uses nephelometers to supplement the air quality network during the field burning season to increase the spatial measurement of $PM_{2.5}$ concentrations in real-time. The nephelometers measure $PM_{2.5}$ indirectly by application of light scattering technology. The method does not meet EPA's reference method

criteria. The advantages of a nephelometer over a TEOM are cost and portability. The nephelometer that DEQ uses is approximately one-half the price of a TEOM. A nephelometer is also smaller and more portable than a TEOM, which makes them easier to set-up and locate at temporary sites. Nephelometer data are output to a datalogger which in turn processes the data into engineering units in 15 minute increments. The 15-minute data are post-processed to calculate hourly $PM_{2.5}$ averages. DEQ and the Kootenai Tribe operated four nephelometers during the 2004 field burning season at the locations described earlier. The Kootenai Tribe nephelometer runs year-round at the Tribal monitoring site.

4. E-BAM

   The E-BAM is a small, portable continuous PM monitor that can be configured to sample $PM_{2.5}$ or PM_{10}. The E-BAM is smaller version of a beta attenuation sampler that EPA approved as an equivalent real-time sampling method for PM_{10}. Beta attenuation uses a radioactive isotope (^{14}C) to produce beta particles and a detector measures the decrease in beta particle intensity as particulates buildup on the filter. The change in beta energy can be related to the particulate concentration. The E-BAM does not meet EPA's reference method criteria for $PM_{2.5}$ measurements. DEQ used the E-BAM sampler at the St. Maries site to provide real-time $PM_{2.5}$ data during the 2004 season.

In summary, a variety of air quality monitoring methods are used to characterize particulate concentrations in north Idaho. During the crop residue disposal smoke management season, DEQ deploys additional equipment to better evaluate the spatial and temporal variability in PM concentrations that can exist when agricultural field burning occurs. This data provides a quantifiable measure to the smoke management coordinators and air quality managers for decision making. The representativeness and quality of the data are important to the SMP. It is therefore important to acquire equipment and develop a network of sites that can meet the program objectives with available resources, knowing that fiscal constraints limit the ability to monitor in every possible downwind location.

Weather Observations

In addition to monitoring for pollutant concentrations, DEQ, the Coeur d'Alene Tribe and the Kootenai Tribe of Idaho also maintain 10-meter meteorological towers (Table 4) that measure wind speed, wind direction, temperature, and other parameters on a continuous basis. The meteorological sensors are maintained and audited to meet USEPA quality assurance criteria for stationary source permitting programs. The data is processed by a datalogger into 15-minute increments and is remotely accessible through a telephone modem. DEQ maintained meteorological sites on the Rathdrum Prairie and in Sandpoint and Pinehurst during the 2004 field burning season. The Kootenai Tribe of Idaho operates a meteorological site in Boundary County under a cooperative agreement with DEQ. The Kootenai Tribe meteorological tower has a similar compliment of sensors with the exception of barometric pressure and relative humidity. The Coeur d'Alene Tribe established a 10 meter meteorological tower in Plummer and maintained the equipment throughout the 2004 season.

Table 4. Description of Real-time Meteorological Monitoring Sites for 2004

Location	County	Parameters Measured
Rathdrum Prairie Met – South of City of Rathdrum	Kootenai	WS, WD, RH, solar radiation, Temp, BP
Univ. of Idaho Ag Research Station – Sandpoint	Bonner	WS, WD, RH, solar radiation, Temp, BP
Bonners Ferry – Kootenai Tribe of Idaho	Boundary	WS, WD, solar radiation, Temp at 2 m and 10 m
Pinehurst Elementary School – City of Pinehurst	Shoshone	WS, WD, RH, solar radiation, Temp, BP
Plummer – Coeur d'Alene Tribe	Benewah	WS, WD, RH, solar radiation, Temp, BP

The wind speed and wind direction data are especially important to the Crop Residue Disposal SMP. Surface wind speeds are part of the prescriptive conditions developed for each airshed that define burn/no-burn days. Surface wind direction is an important parameter in airsheds that have sensitive areas such as busy roadways or housing developments adjacent to the fields. The wind direction and wind speed data from select meteorological stations was processed to develop wind roses for each site. The wind roses were developed for various time intervals including annual, seasonal and burn day periods to show general trends in the surface wind conditions at these sites. The wind rose data is available in Appendix C (will follow at a later date).

Burn Day Evaluations

The CRD smoke management program uses a number of environmental factors as part of the decision making process for determining a burn day. These environmental factors are described for each of the airsheds along with the burn decision process in the *Technical Guidance: Meteorological Services and Field Coordinators for the Idaho Crop Residue Disposal Smoke Management Program*, June 2004. Air quality pollutant levels, i.e., PM concentrations, are one of the many environmental indices considered. DEQ evaluates the air quality data routinely, not only to monitor the status of the network, but to also provide air quality information to the general public through the Air Quality Index (AQI) Program. The AQI program is a national program organized by EPA. Data from participating agencies are posted to the EPA AIRNOW website (www.epa.gov/airnow/index.html) daily along with an air quality forecast for the following day. DEQ submits data from each of the six regional offices to the AIRNOW program.

The AQI Program is a uniform method of reporting to the public about air quality and its relationship to public health. The AQI is divided into six categories with each category having a simple descriptor. As $PM_{2.5}$ concentrations increase from 15 $\mu g/m^3$ to 40 $\mu g/m^3$, air quality drops into the MODERATE category for the AQI. In the MODERATE category, visibility is reduced and the general public can generally notice the change, especially during this time of the year. In the past, $PM_{2.5}$ concentrations at the upper end of the MODERATE category have triggered a no-burn decision.

If $PM_{2.5}$ concentrations increase beyond 40 $\mu g/m^3$ for the 24-hour average and move into the UNHEALTHY FOR SENSITIVE GROUPS (USG) category of the AQI, then burning is not recommended. DEQ can invoke a regulatory burn ban when $PM_{2.5}$ concentrations reach or are expected to reach 50 $\mu g/m^3$ for a 24-hour average. DEQ also has the authority (IDAPA 58.01.01.556) to issue a burn ban when one-hour $PM_{2.5}$ concentrations are expected to reach or have exceeded 80 $\mu g/m^3$.

The ISDA CRD Rule (IDAPA 02.06.16.500.02) requires that no new fires are ignited when $PM_{2.5}$ levels reach 80% of the one-hour criteria for $PM_{2.5}$ (80 $\mu g/m^3$) and are predicted to remain above those levels. When one-hour $PM_{2.5}$ concentrations reach or exceed 64 $\mu g/m^3$, the ISDA can prohibit the growers from igniting any additional fields. This regulatory requirement along with the DEQ one-hour $PM_{2.5}$ criteria necessitates that smoke managers pay close attention to air quality conditions during the burn season.

These air quality indices are used to evaluate burn decisions for the CRD program. They provide an objective measure of the effectiveness of the program and its goal to minimize smoke impacts to the public. Others indicators such as complaints can also be used to measure the effectiveness of the program.

$PM_{2.5}$ levels were monitored daily during the burn season and were a regular topic of discussion during the afternoon and morning burn SMP conference calls with the field coordinators. The ultimate responsibility for making the daily burn decision and giving approval to the grower to burn rests with the ISDA. This responsibility is shared between the field coordinators at the local level and the program manager who oversees the statewide program. Due to the regulatory limits for $PM_{2.5}$ concentrations that are in place by state rule, air quality data is extremely important to the Idaho crop residue disposal SMP.

Focusing on the air quality monitoring data alone as on objective measure, the CRD program was successful at mitigating smoke impacts and keeping $PM_{2.5}$ concentrations below the regulatory trigger levels during the 2004 season. Smoke from regional and local wildfires played a relatively insignificant role in elevating $PM_{2.5}$ concentrations during the 2004 SMP season. The following charts illustrate the variability in the hourly $PM_{2.5}$ data during the month of August. The maximum hourly $PM_{2.5}$ concentration observed during a Rathdrum Prairie burn day was 42 ug/m3 at the Rathdrum monitoring site on August 17. The Kootenai Tribe site near Bonners Ferry measured a maximum hourly concentration of 36 ug/m3 during the September 8 burn day. More details on specific burn days follow in each airshed section.

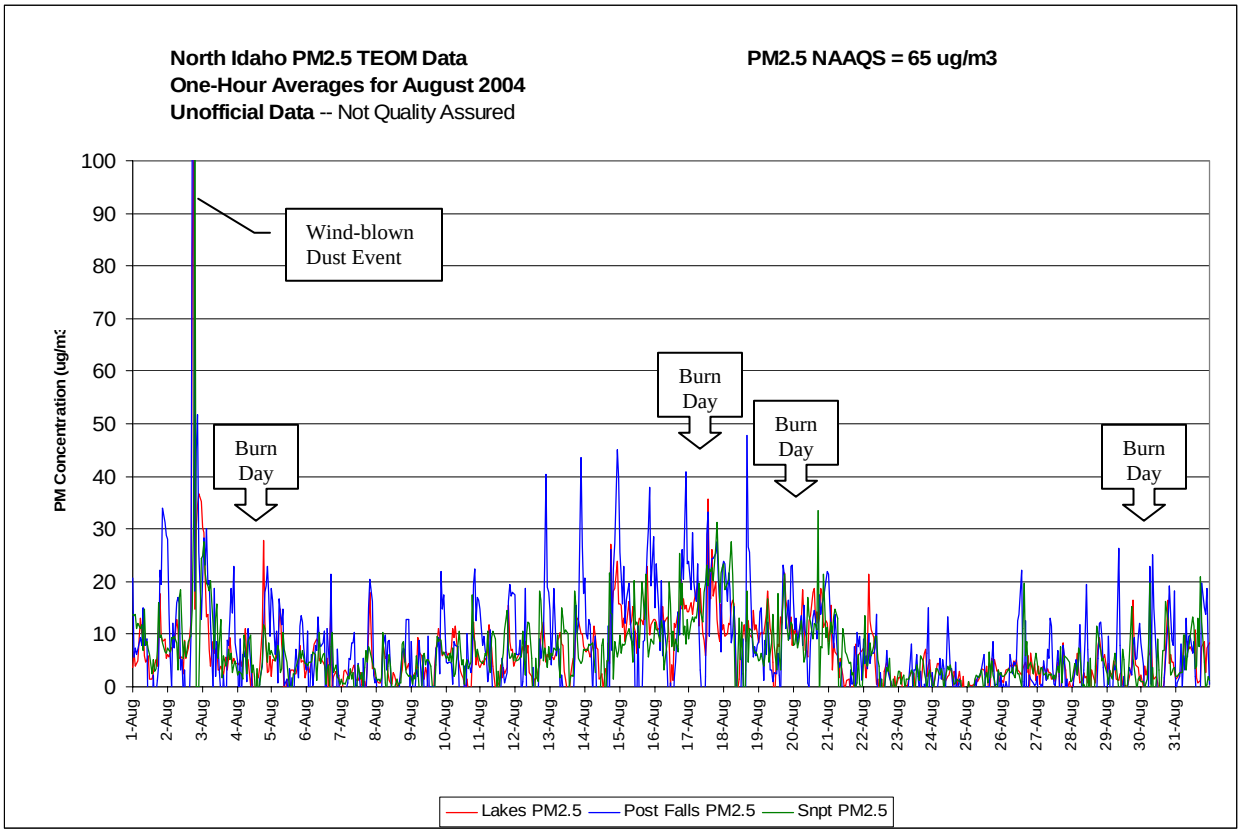


Figure 5. Hourly $PM_{2.5}$ TEOM Concentrations for August 2004 during Rathdrum Prairie Burn Days.

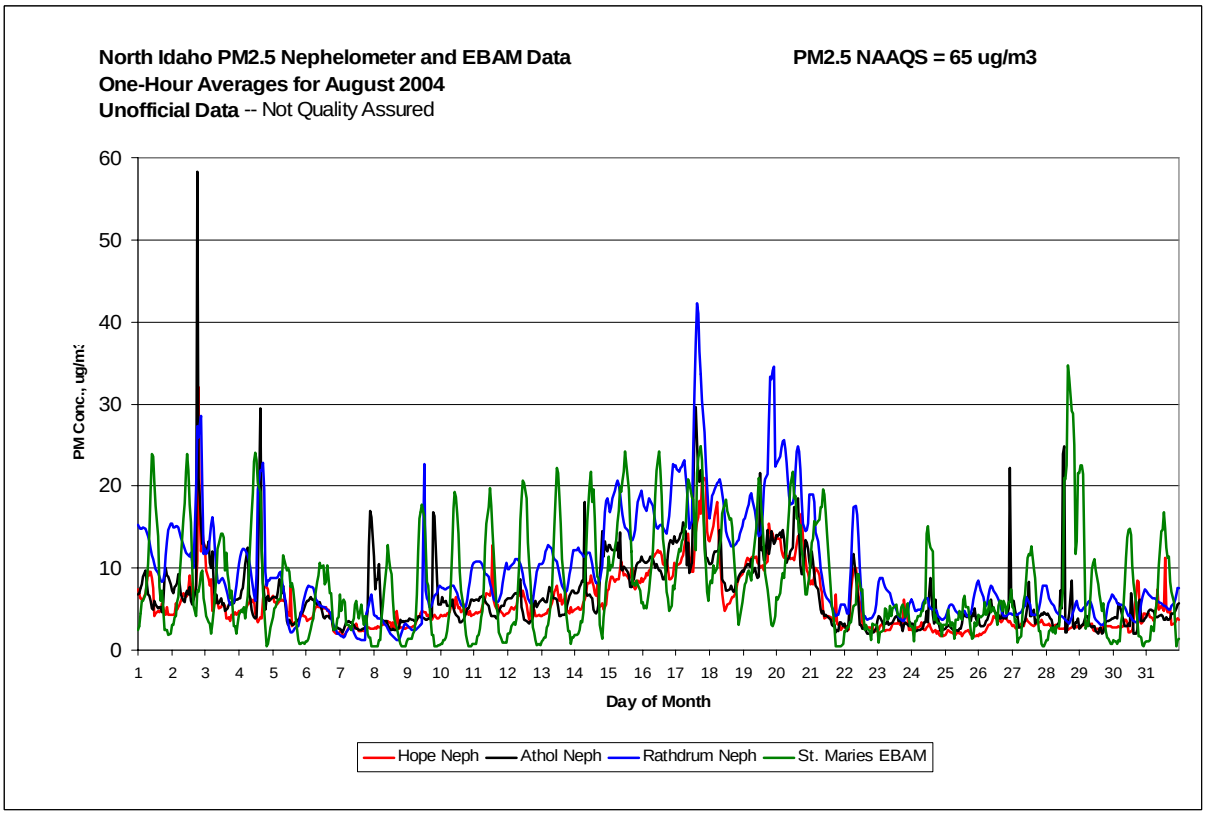


Figure 6. Hourly $PM_{2.5}$ Concentrations for August 2004 from Nephelometer and EBAM sites.

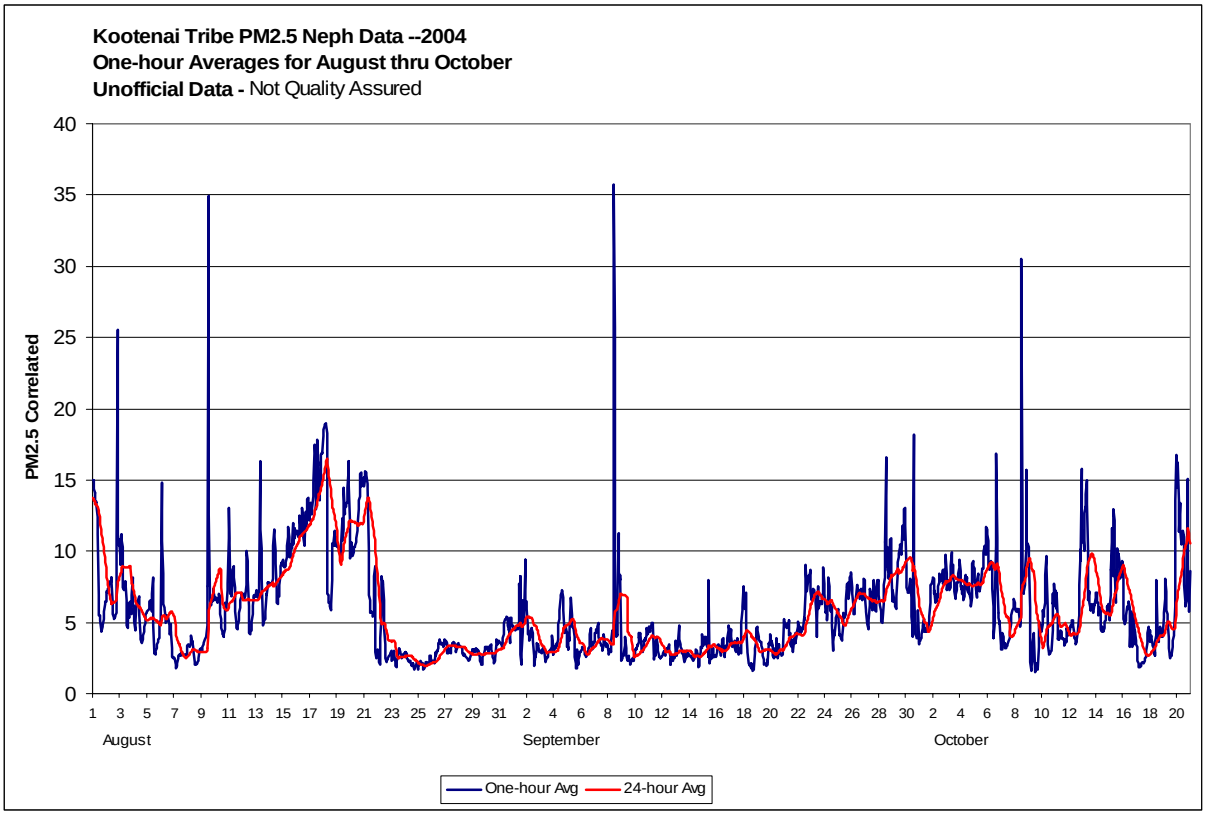


Figure 7. $PM_{2.5}$ Concentrations for August through October 2004 for KTOI site in Boundary County.

AIRSHED DISCUSSION – Rathdrum Prairie

Overview

The Rathdrum Prairie is an area of irrigated agricultural fields and other rural land in Kootenai County. The Rathdrum Prairie is bordered to north by the city of Rathdrum and to the east by the city of Hayden, and to the south by the cities of Post Falls and Coeur d'Alene. These cities form an urban area with over 50,000 residents adjacent to the Rathdrum Prairie. Kootenai County continues to grow and has a population over 115,000.

In 2004, growers registered 3,500 acres of bluegrass seed fields for the CRD program. This represents the fewest number of acres registered on the Rathdrum Prairie since 1987. Growers were able to complete burns on 2,330 acres during five designated burn days (Table 5). Daily burn acres ranged from a low of 300 acres for a test burn to a high of 565 acres.

Table 5. Summary of Rathdrum Prairie Burn Days, $PM_{2.5}$ Concentrations and Hotline Calls.

2004 Burn Days	**Acres Burned**	**Max. 1-hour $PM_{2.5}$ Conc.**, $\mu g/m^3$	Hour Ending Time Period, PST	AQ Monitoring Site	Complaints Reported by Hotline
Thursday July 29	255[1]	32	9 pm	Post Falls	1
Wednesday August 4	300	29	4 pm	Athol	2
Tuesday August 17	370	42	4 pm	Rathdrum	16
Friday August 20	450	34	6 pm	Sandpoint	9
Monday August 30	565	19	8 pm	Post Falls	5
Wednesday September 1	390	33	9 pm	Post Falls	11

July 29th was not a designated burn day on the Rathdrum Prairie. An accidental fire started during the seed harvesting operation and burned a portion of the grass field that was already harvested. The smoke plume dispersed to the east but did not appear to cause any notable smoke impacts. During the rest of the season, all the fields were burned on designated burn days and the fields were all located on the Rathdrum Prairie. Growers in the outlying areas along the Coeur d'Alene River and near the Fighting Creek Landfill south of Coeur d'Alene did not register any fields for burning this year.

Prior to 2003, growers on the Rathdrum Prairie agreed not to burn on Fridays and to limit the total number of burn days to fourteen per year during a 45-day window. These voluntary restrictions were not part of the statewide rules for CRD burning. During the 2003 and 2004 seasons, the growers choose not to exercise the voluntary restrictions and Fridays were included in the burn day evaluation process. ISDA declared Friday August 20 as a burn day on the Rathdrum Prairie and 450 acres were burned.

Burn Day Evaluations

The field coordinators on the Rathdrum Prairie have an abundance of data to evaluate when making a burn decision. As described earlier, a relatively dense network of air monitoring stations provides $PM_{2.5}$ concentrations at a number of locations upwind and downwind of the burn area (Figure 2). Table 5 identifies the five designated burn days on the Rathdrum Prairie in 2004, the acres burned each day, the maximum one-hour $PM_{2.5}$ concentration recorded, and the hour the concentration was recorded.

For the 2004 season, the smoke management program was successful at reducing the number of complaints compared to previous years. The hotline service reported about 43 complaints for the season which is a record low for this area. The 2004 season was a record low year for total number of acres burned with only 2,330 acres burned including one accidental fire.

Wildfire smoke impacted the area in late July with peak one-hour concentrations reaching 95 μg/m3 during the morning of July 27. These high concentrations would have contributed to a no-burn decision for that day. During the month of August, wildfire smoke did not impact the area and did not contribute to any burn restrictions on the Rathdrum Prairie in August. Generally, if the background or pre-ignition ambient $PM_{2.5}$ concentrations rose above 15 $\mu g/m^3$ for the 24-hour average, then more consideration was given to the increased PM levels during the burn decision process

The first designated burn day on the Rathdrum Prairie occurred on August 4 when a 300 acre field was burned. The burn went fairly well with good plume rise and dispersion for most of the burn duration. At the end of the burn, smoke ended up on the ground and created smoke impacts on the west side of the prairie. The surface winds were light and variable and a northeast surface wind moved the smoke into the west side of Post Falls. No air quality monitoring site was in the area of smoke impact to record the event. A detailed analysis of the event was completed by DEQ and is available in Appendix A of this report. This burn day exemplifies the fact that air quality monitoring data alone does not tell the whole picture of the smoke management program. Even though the burn day met the Rathdrum Prairie burn prescription, the outcome shows the inherit risks in trying to manage this activity in this particular airshed. If the winds had changed to a more northerly direction or northwest direction, the outcome could have been much worse with significant impacts to the more populated areas of Post Falls or Coeur d'Alene.

The burn day on August 17 produced the most complaints and the highest recorded $PM_{2.5}$ one-hour concentration for the season. Weather data from the Coeur d'Alene airport showed average wind speeds of 10 to 14 mph with gusts 20 to 24 mph during the burn period. The 2004 Technical Guidance document identifies in the Rathdrum Prairie prescription a surface wind speed criteria of 5 to10 mph with gusts not to exceed 15 mph. The strong surface winds that day pushed the smoke plume horizontally and did not allow for adequate vertical plume rise. This put more smoke on or near the ground and increased the level of downwind impact. Under certain conditions, high winds do aid with field ignition and combustion, sometimes resulting in a hotter, more effective burn. If the surface winds are persistent throughout the day, the smoke is rapidly dispersed once the burn is complete and $PM_{2.5}$ concentrations generally drop quickly.

DEQ did not have personnel available for field observations the August 20 burn day. Staff were available to observe the smoke plumes on the August 30 and September 1 burn days.

Figure 8. Photograph of smoke plume from August 17 burn day on Rathdrum Prairie.

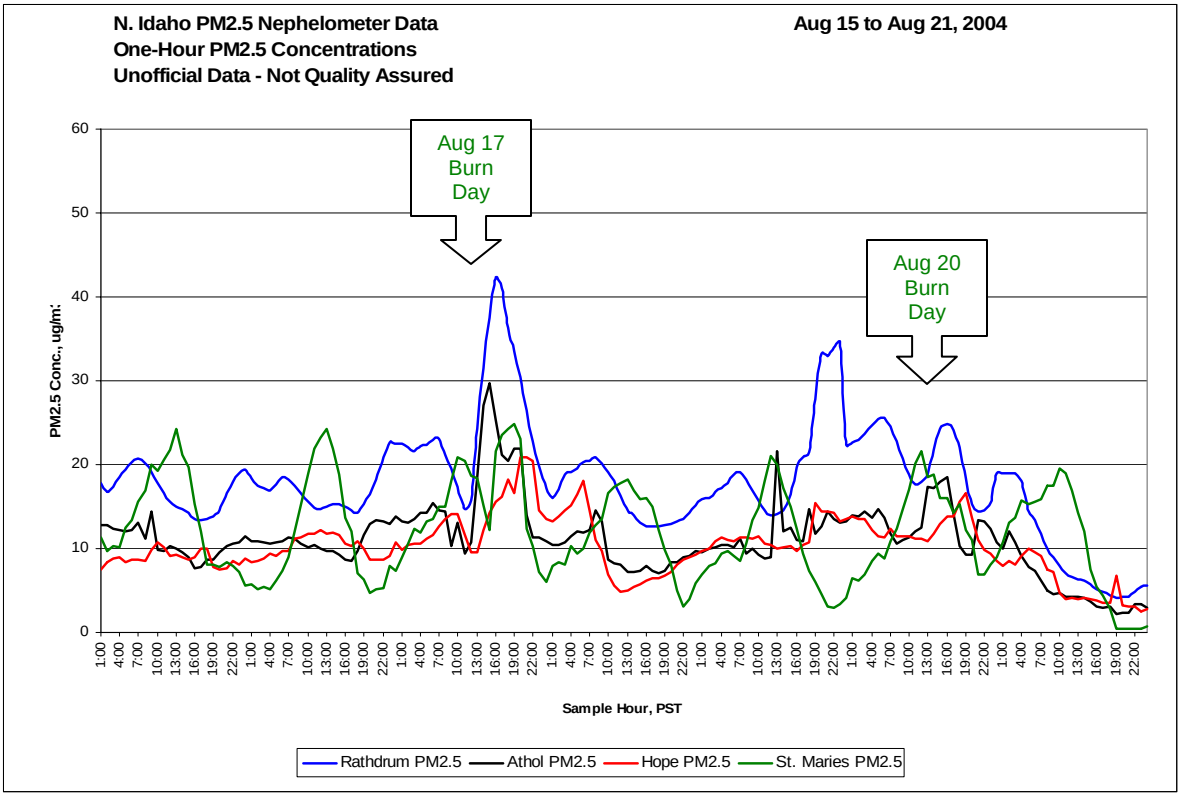


Figure 9. One-hour Average $PM_{2.5}$ Concentrations during Two Burn Days on Rathdrum Prairie.

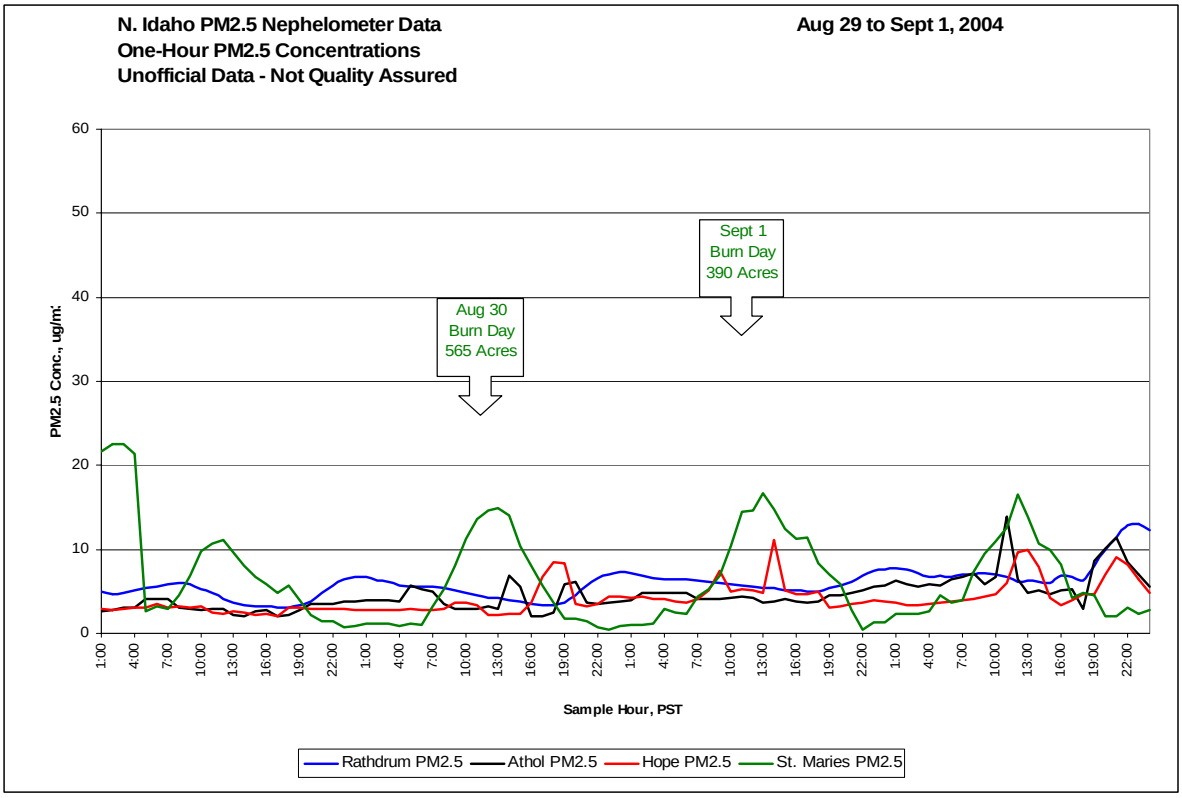


Figure 10. One-hour Average $PM_{2.5}$ Concentrations during Two Burn Days on Rathdrum Prairie.

Figure 11. Smoke plume moving to the NE from August 30 burn day on Rathdrum Prairie.

The smoke management CRD program needs to identify a background level for the Rathdrum Praire prescription that will trigger either a Conditional or No-burn decision. Presently, field coordinators and SMP managers have not formalized a level at which this action occurs. DEQ recommends that ISDA adopt a background level of 30 $\mu g/m^3$ (24-hour $PM_{2.5}$ concentrations) at which a no-burn decision is triggered by the SMP.

Weather Forecasts

In the burn decision process, forecasting the weather is probably the most difficult part of the equation. Field coordinators have a number of tools available to them to aid them in their burn recommendation. These tools are described briefly in the *Technical Guidance: Meteorological Services and Field Coordinators* document, June 2004. In addition to the various products that are available through the Internet, a weather forecast and a burn recommendation specific to the Rathdrum Prairie were provided twice per day from the contract meteorological service supporting the SMP. This SMP forecast included an hourly ventilation rating during the burn time period (8 a.m. to 5 p.m.) and a burn recommendation (no burn, conditional or burn).

For local weather data, the Rathdrum Prairie field coordinators had access to surface observations collected by the DEQ meteorological station, the Coeur d'Alene Airport data posted on the Internet, and direct observation with hand-held sensors or other instruments. The field coordinators also measured upper air parameters by releasing pilot balloons (pi-bals) and tracking their movement through the atmosphere. Pibals were released on the Rathdrum Prairie and on the Coeur d'Alene Indian Reservation in Plummer. The field coordinators process pibal data to determine wind speed and wind direction at one-minute intervals through the atmosphere. During a typical observation, winds are observed to a height of approximately 9,000 to 12,000 feet above ground level. These observations were shared with the smoke management team.

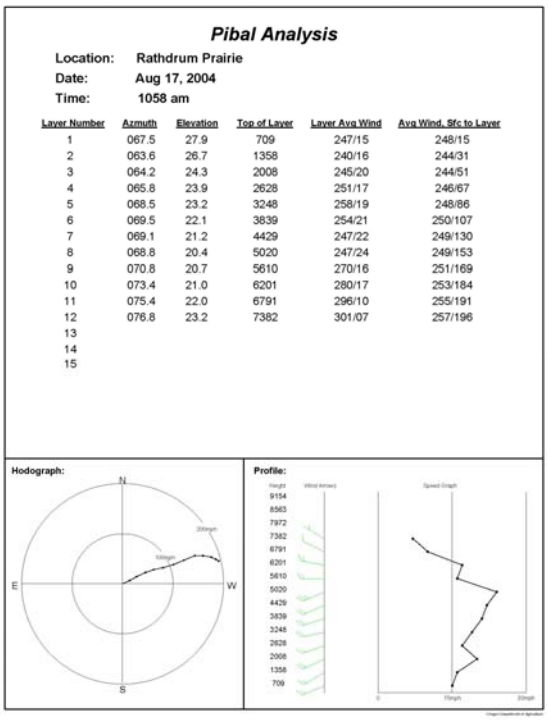
Historically, the pibal data was an important tool for burn coordinators on the Rathdrum Prairie. This tool played a significant role in the burn decision process. In the past, this focus on the use of pibal data may have contributed to burn decisions that resulted in significant smoke impacts to populated areas, either from unexpected changes in weather or from overloading the dispersion capacity of the atmosphere with smoke from too many burned acres. As the SMP continues to evolve, there is a greater emphasis on the use of sophisticated forecast models to evaluate downwind transport of smoke plumes. The pibal data continues to be an important and practical tool for smoke coordinators. The field coordinators should use the pibal data to ground-truth or validate various modeled forecast products such as the upper air winds in the 850mb or 700mb products.

The pibal data can accurately show wind direction and wind speed for the general location of the balloon release. This can be a useful tool especially if the observation is near the fields planned for burning. The pibal data is very useful information for identifying proper weather conditions at the point of ignition especially in areas where there are numerous sensitive zones close to the grass fields and the margin of error is small.

Pibal data are not as useful for long-range downwind dispersion especially in areas with complex terrain. Topography and terrain can have a significant influence on surface wind conditions. Pibal measurements from the Rathdrum and Plummer sites for the same elevation and time

period can be significantly different. The accuracy of the data is also a concern. Error can also be introduced from recording the field measurements and is inherent in the calculations that assume a constant rate of balloon rise. Other environmental parameters affect the accuracy of the pibal measurements. Downwind features such as large water bodies or mountain ridges can produce atmospheric effects that are not represented by the pibal measurements. Figures 12 and 13 below illustrate the differences in wind speed and direction observed at approximately the same time at two locations nearly 35 miles apart.

From our perspective, additional tools such as the MM5 forecasts and ClearSky dispersion model are necessary for the prediction of regional plume movement. For sensitive airsheds such as the Rathdrum Prairie, regional smoke impacts can occur beyond the field of view of the field coordinator and the area of ignition. The sophisticated computer models factor in the effect of terrain, topography and other phenomenon that influence the movement of air masses in both horizontal and vertical planes.



Pibal Analysis

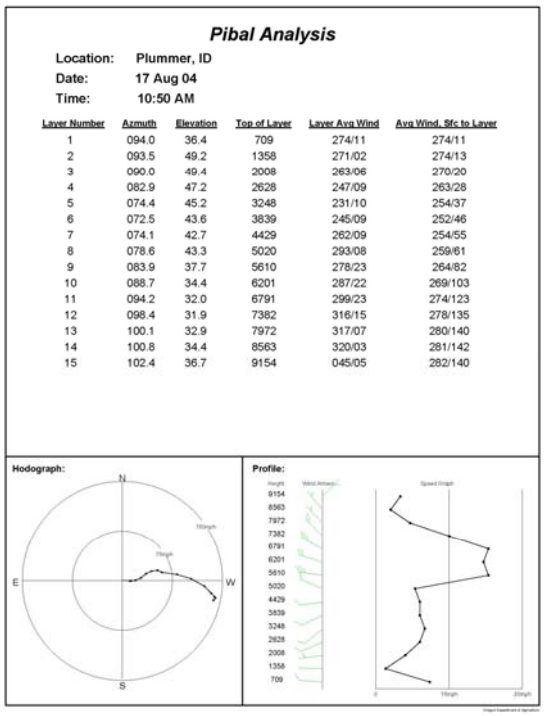
Location: Rathdrum Prairie
Date: Aug 17, 2004
Time: 1058 am

Layer Number	Azmuth	Elevation	Top of Layer	Layer Avg Wind	Avg Wind, Sfc to Layer
1	067.5	27.9	709	247/15	248/15
2	063.6	26.7	1358	240/16	244/31
3	064.2	24.3	2008	245/20	244/51
4	065.8	23.9	2628	251/17	246/67
5	068.5	23.2	3248	258/19	248/86
6	069.5	22.1	3839	254/21	250/107
7	069.1	21.2	4429	247/22	249/130
8	068.8	20.4	5020	247/24	249/153
9	070.8	20.7	5610	270/16	251/169
10	073.4	21.0	6201	280/17	253/184
11	075.4	22.0	6791	296/10	255/191
12	076.8	23.2	7382	301/07	257/196
13					
14					
15					

Hodograph: N E W S

Profile: 9154 8563 7972 7382 6791 6201 5610 5020 4429 3839 3248 2628 2008 1358 709

Figure 12. Rathdrum Prairie Pibal Run from August 17, 2004



Pibal Analysis

Location: Plummer, ID
Date: 17 Aug 04
Time: 10:50 AM

Layer Number	Azmuth	Elevation	Top of Layer	Layer Avg Wind	Avg Wind, Sfc to Layer
1	094.0	36.4	709	274/11	274/11
2	093.5	49.2	1358	271/02	274/13
3	090.0	49.4	2008	263/06	270/20
4	082.9	47.2	2628	247/09	263/28
5	074.4	45.2	3248	231/10	254/37
6	072.5	43.6	3839	245/09	252/46
7	074.1	42.7	4429	262/09	254/55
8	078.6	43.3	5020	293/08	259/61
9	083.9	37.7	5610	278/23	264/82
10	088.7	34.4	6201	287/22	269/103
11	094.2	32.0	6791	299/23	274/123
12	098.4	31.9	7382	316/15	278/135
13	100.1	32.9	7972	317/07	280/140
14	100.8	34.4	8563	320/03	281/142
15	102.4	36.7	9154	045/05	282/140

Hodograph: N E W S

Profile: 9154 8563 7972 7382 6791 6201 5610 5020 4429 3839 3248 2628 2008 1358 709

Figure 13. Coeur d'Alene Tribe Pibal run for August 17, 2004.

ClearSky Modeling Review

The ClearSky model was designed to provide smoke managers with a web-based tool to estimate long-range plume movement and smoke impacts. As the model performance improves, the field coordinators can also use the model to test various burn scenarios to evaluate the airshed's capacity to disperse more or less smoke.

ClearSky was operational for the Rathdrum Prairie and Coeur d'Alene Indian Reservation during the 2004 burn season. The model was programmed to run daily default scenarios for burns in these two smoke management areas. Field coordinators and DEQ staff could also submit proposed scenarios that might closely replicate the burns planned for the following day.

During the 2004 season, the Rathdrum Prairie field coordinators submitted alternative scenarios to evaluate the effect of increasing or decreasing burn acres. A default scenario of 1,500 acres ran daily. However, field staff continue to express dissatisfaction with the model especially with the timing of model output products. Field staff would like the ClearSky model to utilize the most current MM5 outputs (12z runs) to increase the reliability of the plume predictions.

The strengths and weaknesses of the ClearSky model were discussed in the 2003 Technical Review document with a specific focus on the Rathdrum Prairie from a user's perspective. The model development team at Washington State University (WSU) is continually working to refine and improve the model. WSU conducted field studies in 2004 to evaluate plume rise parameters and other physical parameters. The field investigations should lead to further improvements for the 2005 season. The 2004 ClearSky report by WSU should provide more details on the model performance in 2004 and the anticipated improvements for 2005.

Rathdrum Prairie Airshed Summary

The field coordinators on the Rathdrum Prairie have one of the most challenging smoke management jobs in the statewide program. The grass fields located on the Prairie are nearly surrounded with urbanized cities and growing rural residential communities. The smoke manager's ability to predict how smoke will move from the fields and disperse quickly with minimal impact to the public is very difficult. One small change in the weather or a field condition, e.g. fuel moisture, can result in an undesirable smoke impact to a downwind area. The August 4 burn day was a good example of the effect of a wind change at the end of a burn.

For the 2004, the Rathdrum Prairie field coordinator was one of the most experienced smoke coordinators in the state. This experience combined with local growers skilled in field burning practices and smoke management makes for a good working relationship on the ground. The Rathdrum Prairie airshed has one of the most extensive set of technical tools available to support the program. As discussed in this report, this toolbox includes upper air measurements with pibals, forecast support from a contract meteorologist, ClearSky modeling runs, direct access to an extensive downwind monitoring network, and a field office centrally located on the prairie for on-the-ground observations and coordination. Even with all these tools, the program was unable to completely avoid downwind smoke impacts from occurring.

The combination of experienced managers and extensive technical support allows the SMP to track numerous environmental parameters that go into making a burn decision. The smoke

managers must find a balance of environmental parameters for good smoke dispersion, plume rise and fire safety with a limited amount of time each day for practical and functional coordination with the growers. The coordinators must also continue to improve their technical skills, stay current with emerging technology, and incorporate new information into the decision making process.

Recommendations for the 2004 Season include the following;

- Identify and adopt in the CRD Smoke Management Plan a 24-hour $PM_{2.5}$ background concentration that triggers a no-burn decision. DEQ recommends a value no greater than 30 $\mu g/m^3$.

- Develop techniques for field coordinators to use pibal data or other upper air measurements, i.e. sodar, to validate MM5 upper air forecast products like 850mb winds for the Rathdrum Prairie Airshed.

- Continue the application of the ClearSky model for the Rathdrum airshed and support model improvements to increase performance of the model and its applicability to the CRD smoke management program.

- Closely monitor surface winds on burn days to reduce wind induced smoke impacts.

- Develop a process for incorporating real-time complaint information into the burn decision and burn decision evaluations. This is particularly important when recognizing that air quality monitoring cannot cover all possible downwind impacts.

- Promote alternative crop management practices that reduce demand for field burning yet sustain the agricultural viability of Kentucky bluegrass production on the prairie.

AIRSHED DISCUSSION -- Boundary County

Overview

The Kootenai River Valley is the major agricultural area in Boundary County with rich farmland along the flat river bottoms and adjacent benches. In Idaho, the Kootenai River runs from east to west as it passes through the city of Bonners Ferry and then turns to the north/northwest as it meanders into British Columbia, Canada. As the crow flies, the valley runs for approximately 25 miles from one end to the other. Growers use fire to manage crop residue on cereal grain fields. Boundary County differs from the Rathdrum Prairie in that most of the acres burned in Boundary County are stubble fields from grain production. Perennial grass fields make up a small percentage of the total acres in this valley.

The Selkirk Range is located on the west side and creates a dramatic valley boundary, rising 3000 ft. above the valley floor within one mile from the western edge of the valley. The mountain peaks top out at 6,000 to 6,800 ft. throughout the north-south oriented range. The eastern boundary is less dramatic with ridge tops at 4000 to 5000 ft. elevations. These geographic features have a strong influence on the local weather patterns and play a significant role in the agricultural smoke management program.

2004 was the third year of the implementing the statewide registration program and Boundary County growers registered nearly 8,700 acres for burning. During the 2004 season, growers burned 6,626 acres on 13 burn days in Boundary County. Acres burned per day ranged from a low of 50 acres for test burns to a high of 1,665 acres. The current airshed prescription for Boundary County established limits of 2,400 acres for a burn day and 600 acres for a conditional day. The burn season is summarized in Table 6 with burn acres broken out by irrigation districts established in the valley. Maximum hourly impacts recorded at the Kootenai Tribe air quality site and complaints received by the hotline are also identified in Table 6.

Weather was the main factor that affected the CRD program during 2004. Poor dispersion conditions and periods of high precipitation limited the number of days for burning. This resulted in a backlog of acres as the season progressed. The few bluegrass fields that are in the valley experienced new growth and green-up while waiting for a good burn day. This further compounded the ability to burn these fields during the later part of the 2004 season.

Table 6. Summary of Boundary County Burn Days, $PM_{2.5}$ Concentrations and Hotline Calls.

	Acres Burned	Location of field relative to KTOI site	Max. 1-hr PM2.5 conc. (µg/m³)	Hour Ending Time Period (PST)	Complaints Received by Hotline
7-02-2004	No Burn		8.5µg/m³	11:00pm	1
8-09-2004	50 acres	District 11	35.0µg/m³	1:00pm	0
8-20-2004	100 acres	District 11	15.6µg/m³	8:00pm	0
8-21-2004	No Burn		15.7µg/m³	4:00am	1
8-31-2004	310 acres	District 6	5.5µg/m³	10:00pm	1
9-08-2004	1030 acres 290 acres 205 acres 90 acres 50 acres	District 6 District 9 District 5 District 11 Peterson Hill	35.8µg/m³	12:00pm	14
9-09-2004	No Burn		4.0µg/m³	8:00am	1
9-11-2004	No Burn		5.0µg/m³	8:00am	1
9-20-2004	100 acres	District 11	5.2µg/m³	12:00am	0
9-21-2004	110 acres 201 acres	District 11 District 13	5.1µg/m³	10:00am	0
9-22-2004	90 acres 40 acres 285 acres 247 acres 160 acres	District 9 District 13 District 6 District 4 District 11	9.1µg/m³	4:00pm	1
9-23-2004	185 acres 190 acres 325 acres	District 11 District 1 District 4	8.8µg/m³	11:00pm	1
9-24-2004	74 acres	District 13	8.2µg/m³	8:00am	0
9-27-2004	71 acres 40 acres 50 acres	District 13 District 11 Highway 1	8:0µg/m³	3:00pm	0
9-30-2004	No Burn		18.2µg/m³	3:00pm	1
10-05-2004	275 acres	District 8	11.7µg/m³	11:00pm	0
10-08-2004	700 acres 592acres 150 acres	District 8 District 2 District 11	30.5µg/m³	2:00pm	1
10-12-2004	200 acres	District 6	15.8µg/m³	12:00am	2
11-08-2004	No Burn		40.32µg/m³	8:00pm	1

<u>District locations relative to KTOI site</u>:

-District 1, 2.5 miles South of KTOI Mission
-District 2, 6.9 miles East of KTOI Mission
-District 4, 11.7 North of KTOI Mission
-District 5, 4.9 miles North of KTOI Mission
-District 6, 16 miles North of KTOI Mission
-District 8, 20 miles North of KTOI Mission
-District 9, 13.7 miles North of KTOI Mission
-District 11, 1.9 miles Surrounding KTOI Mission
-District 13, 15 miles North of KTOI Mission
-Highway 1, 12.6 miles North of KTOI Mission
-Peterson Hill, 4 miles South of KTOI Mission

Burn Day Evaluations

The field coordinator in Boundary County has fewer technical resources available for making a burn decision as compared to the Rathdrum Prairie. The field coordinator released balloons for visual observations during the season but did not have the resources available to conduct pibal measurements. The ClearSky model was expanded to include Boundary County this year. WSU developed a field selection page to allow the smoke management team to develop various scenarios as needed.

The University of Washington MM5 website provided forecast products that include Boundary County in the 4 km and 12 km domains, but little work has been done to reconcile the forecast products with actual weather conditions in this airshed. The field coordinator found the forecast products, especially the Ventilation Indexes that predict surface winds (20 meters), very unreliable. The simple balloon release and observation helped provide more accurate information on the direction of upper air winds that the weather models had difficulty predicting.

An assessment of the burn day decisions was more difficult in this airshed because of the limited air quality data available as compared to the Rathdrum Prairie. The Kootenai Tribe of Idaho operates an air quality monitoring site on the reservation located northwest of the City of Bonners Ferry. As described earlier in this report, the Tribal air quality site collects $PM_{2.5}$ data and surface weather data with continuous sampling methods. See Tables 3 and 4.

The air quality data from the Tribal site provides limited spatial resolution of the $PM_{2.5}$ concentrations that occur in the Kootenai River Valley. Additional monitoring sites are needed to better characterize the $PM_{2.5}$ spatial variability that may exist especially when agricultural burning, wildfires and slash burning are contributing smoke to the airshed.

Figures 14 and 15 show the one-hour average $PM_{2.5}$ concentrations measured by the nephelometer at the Kootenai Tribe site for August and September 2004. As mentioned earlier, the nephelometer provides an indirect measure of particulate concentrations by using a light scattering measurement technique. The nephelometer scattering data is correlated with a $PM_{2.5}$ reference method to generate $PM_{2.5}$ concentrations. Included with the $PM_{2.5}$ data from the Kootenai Tribe site is $PM_{2.5}$ data from the Hope site in Bonner County for comparison. Not all the burn days are identified in these figures. Refer to Table 6 for a complete list of burn days. The two burn days identified exhibit $PM_{2.5}$ spikes associated with smoke impacts from field burning.

The $PM_{2.5}$ data for the field season shows that Kootenai Tribe site did not capture any significant smoke impacts. Hourly concentrations stayed below the regulatory trigger levels that were described earlier in this report. This data, with similar spatial coverage limitations as described in the Rathdrum Prairie section, shows that the smoke management program was successful in managing smoke in the southern part of the Kootenai River Valley. PM data from the air quality monitoring site in Creston, BC has not been evaluated for smoke impacts during the 2004 season. Plans to install additional $PM_{2.5}$ continuous monitors in the Creston Valley prior to the burn season were unsuccessful. A new site and additional monitors in the Creston area should be functional by the 2005 season. Complaints from the Creston area were also down compared to last year and this trend supports the efforts of the CRD program to minimize downwind impacts in the Creston area.

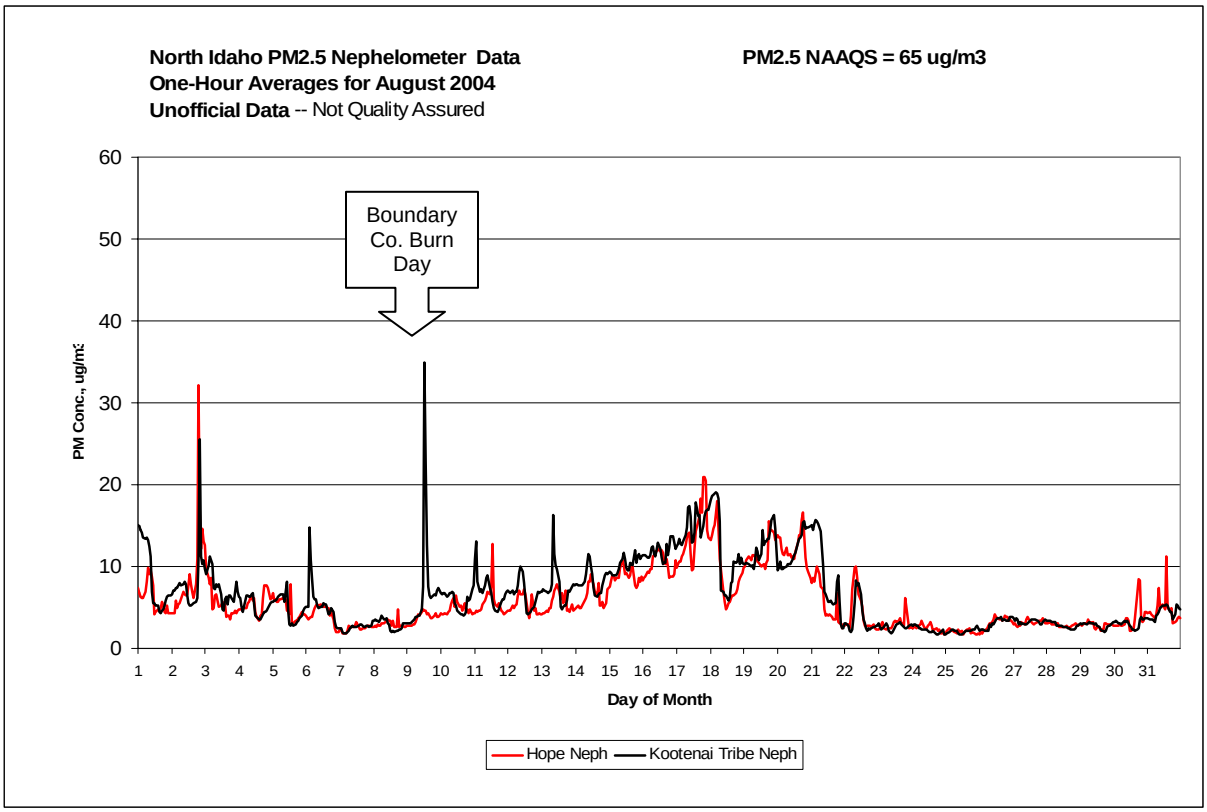


Figure 14. $PM_{2.5}$ Concentrations for August 2004 from the Kootenai Tribe and Hope sites.

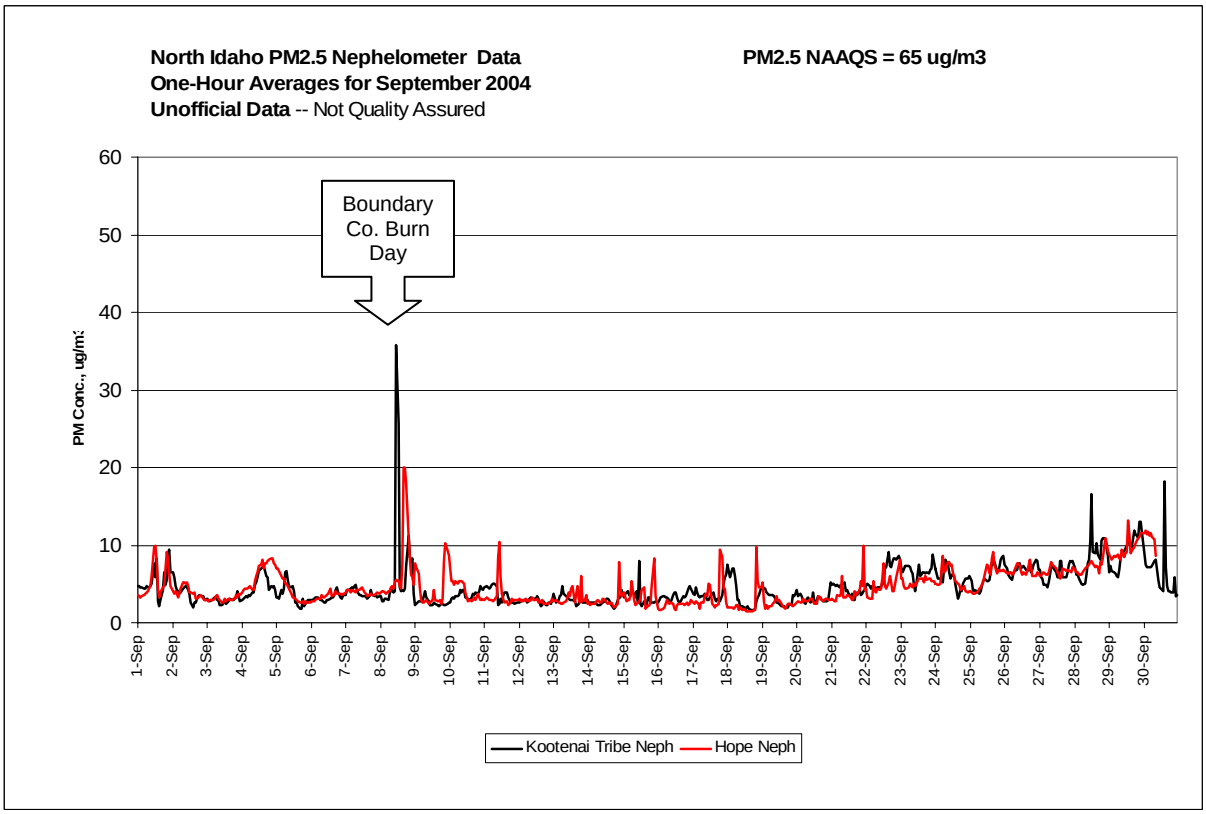


Figure 15. $PM_{2.5}$ Concentrations for September 2004 from the Kootenai Tribe and Hope sites.

Wildfire Smoke Impacts

Wildfire smoke did not create significant impacts in Boundary County during the 2004 season. Wildfire smoke contributed to a gradual increase in background $PM_{2.5}$ concentrations during the middle part of August. The $PM_{2.5}$ levels peaked into the MODERATE AQI category for one day before dropping back down into the GOOD range for the rest of the season.

Weather Forecasts

In Boundary County, the smoke management program had to rely on weather forecast products derived from the National Weather Service, the daily forecasts and burn recommendations from SMP contract meteorological service and the MM5 forecast products from the University of Washington. Actual data was limited to surface observations made by at the Kootenai Tribe site and by other surface meteorological stations such as the USFS RAWS site in Bonners Ferry. Long-time residents of the Kootenai River Valley have noted that weather forecasts from the Spokane or Missoula NWS offices are not very reliable for this valley.

The ClearSky modeling program was expanded to include Boundary County for the 2004 season. However due to technical limitations with Internet access for the field coordinator, the availability of ClearSky products was limited throughout the burn season. The model output products take considerable time to download and view using a dial-up modem connection. High speed broadband service is limited in the Kootenai River valley.

DEQ will complete an analysis of the 10-meter wind data from the Kootenai Tribe site with a wind rose software package. This analysis will include daily, seasonal and annual average wind roses from the 2004 data set. The complete set of wind roses for Boundary County will follow at a later date in Appendix C of this report.

Boundary County Airshed Summary

The CRD smoke management program in Boundary County is still maturing. The growers have run an informal program for several years prior to the development of the ISDA statewide program. That local experience and knowledge must now be transferred or acquired by the ISDA program. The technical tools that are needed to support the program are also still in the growth phase. A partnership with the Kootenai Tribe has provided air quality and weather data representing a portion of the Kootenai River Valley. Other partnerships must be developed to further enhance environmental monitoring for this airshed, especially in the areas downwind of burning.

Formal agreements with the British Columbia Ministry of Water, Land and Air Protection (BC WLAP) may provide additional information from the Creston Valley area and other technical support from staff in British Columbia.

Recommendations for improvements in 2005 in Boundary County:

- Improve access to air quality data collected by the Kootenai Tribe. The Tribe is presently working on modifications to their communication network that will likely improve access to the data by the Boundary County field coordinator and others in 2005.
- Increase collection of upper air data in Boundary County to address the complex terrain and limited surface meteorological data. This may include collection of pibal data or the deployment of upper air sounding equipment like a SODAR.
- ISDA needs additional field staff to assist with data collection, coordination with growers and tracking downwind smoke plume movements.
- Increase training of field coordinator on utilization of ClearSky, especially the interpretation of plume model products. Improved access to high-speed broadband service may also help with distribution of web-based information.
- Increase outreach to growers and surrounding community on the CRD smoke management program, as well as coordination with other land managers involved in smoke management.
- Improve the accuracy of the CRD database for tracking acres burned each day. Reconciling total acreage and the number of burn days is an ongoing problem.

Appendices

Appendix A.

Analysis of August 4, 2004 Burn Day on the Rathdrum Prairie by DEQ

Appendix B

Analysis of Smoke Event on September 8, 2004 by Bennett Fire Weather Forecasting, Inc.

Appendix C

Wind Rose Analysis of 10-meter Meteorological sites in Kootenai, Bonner and Boundary Counties.